NCAR Activity Update

To the NEXRAD TAC
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San Diego, CA

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New logo for the Earth Observing Laboratory

NCAR

NCAR UPDATE

- Roger Wakimoto new EOL director now in place
  - New subdivision managers are in place
- S-Pol's RVP8 updated with SIGMET's new 72 MHz IFD (intermediate frequency digitizer) and Receiver card
  - Very important for Zdr stability!! i.e., both H&V channels on one card.
  - S-Pol is set up at Marshall Field Site and ready to take data
- Purchased new RVP8 time stamp capability for multiple radar synchronization (i.e., K-Pol)
- Developing a real time AP mitigation algorithm, CMD (Clutter Mitigation Decision)
- Preparing for Zdr calibration experiment
- Investigating over lapping time series window functions for increased data quality

EOL
Deployment
Development
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Real Time AP Mitigation With and Without SZ Phase Coding

- For long PRT scans (or upper elevation scans): calculate moments and then identify clutter affected regions via CMD. Then clutter filter those regions and recalculate moments.
  - Could define both NP and AP clutter at this time for use on SZ scan.
- For SZ scans: use clutter map, calculate SZ moments, identify clutter regions via CMD, then rerun SZ algo. on those clutter affected areas.

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The AP PROBLEM

Present mitigation methods:

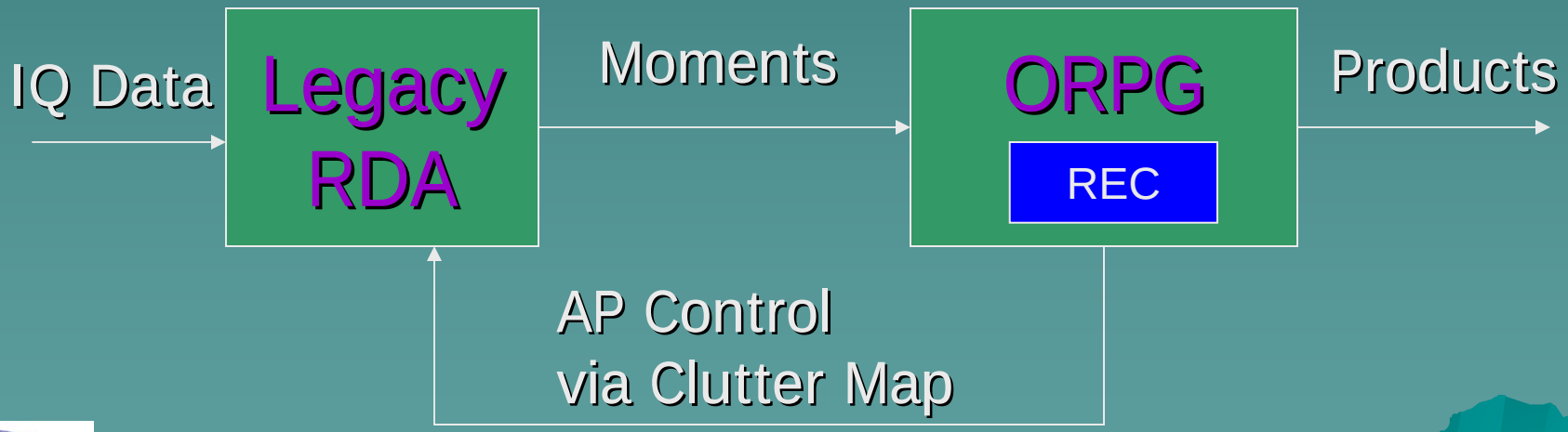
- Turn clutter filters on all of the time
- Attempt to use operator defined AP areas
  - Operator intensive
  - When to turn off?
- Solution, Detect and correct AP clutter in real time: CMD Algorithm

CMD: CLUTTER MITIGATION DECISION

- Fuzzy logic algorithm using inputs reflectivity, velocity, width, and spectral variables.
- Designed for real time operation on ORDA.
- Also *can* use dual polarization variables. This allows for performance comparison testing.

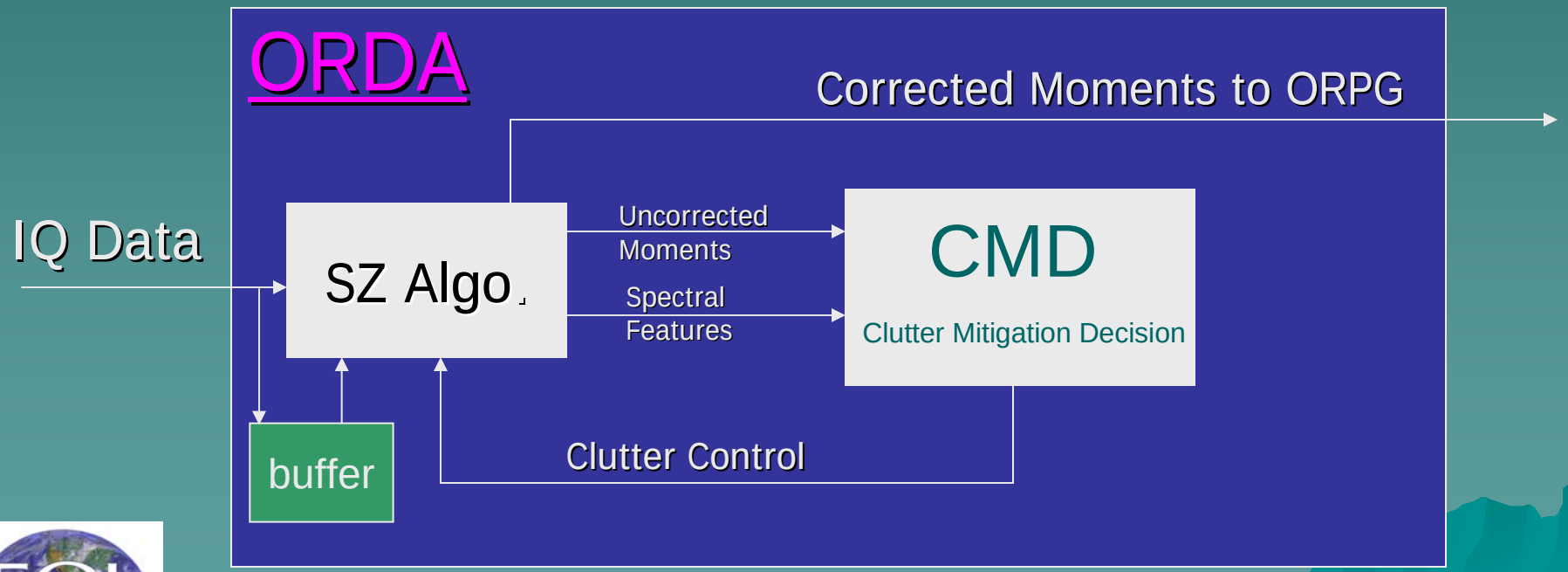
Migration of AP Detection into ORDA

Current System



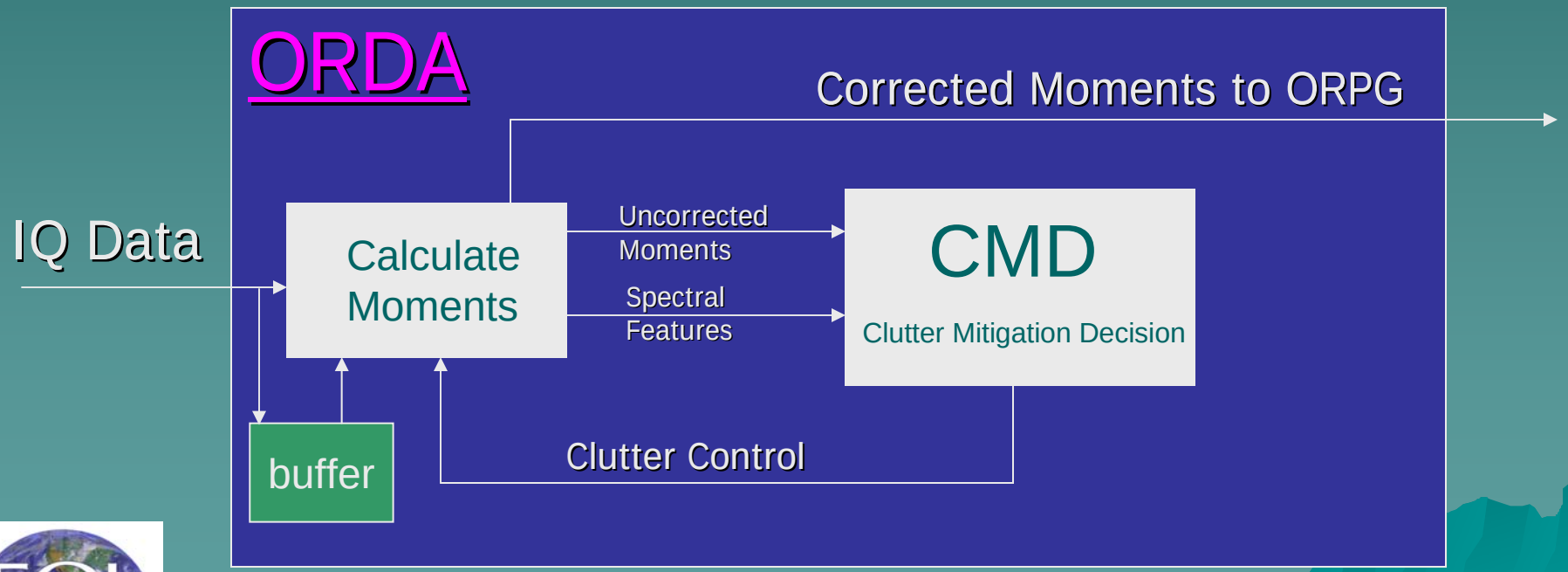
Migration of AP Detection into ORDA

New RVP8 Based RDA



Migration of AP Detection into ORDA

For the Long PRT scans or upper elevation scans



CMD PERFORMANCE BENIFITS

- Apply clutter filter only when and where needed
- Reduces computation time
- Eliminates human error
- Reveals weather signatures that are masked by clutter
- May eliminate use of clutter maps, i.e., CMD can identify both NP as well as AP clutter
  - CMD Ground Clutter Maps could be generated for comparison to known NP maps (enhance operator confidence)
- Enhance Data Quality!

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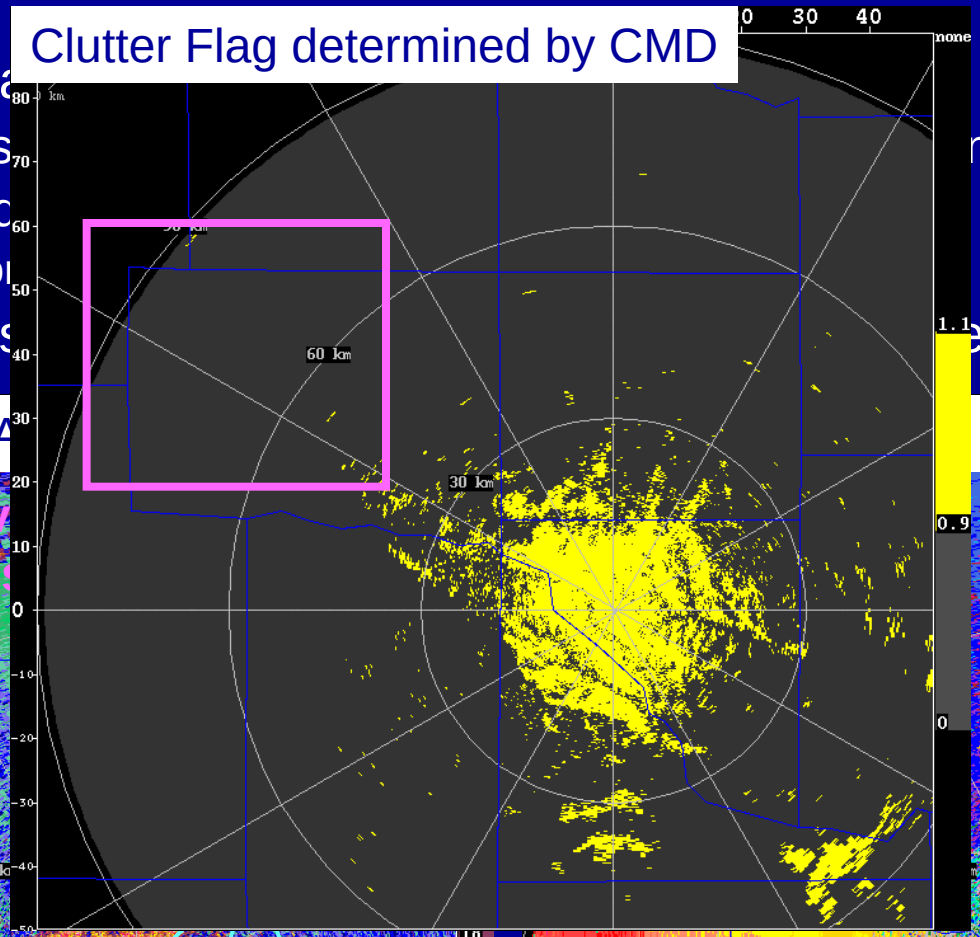
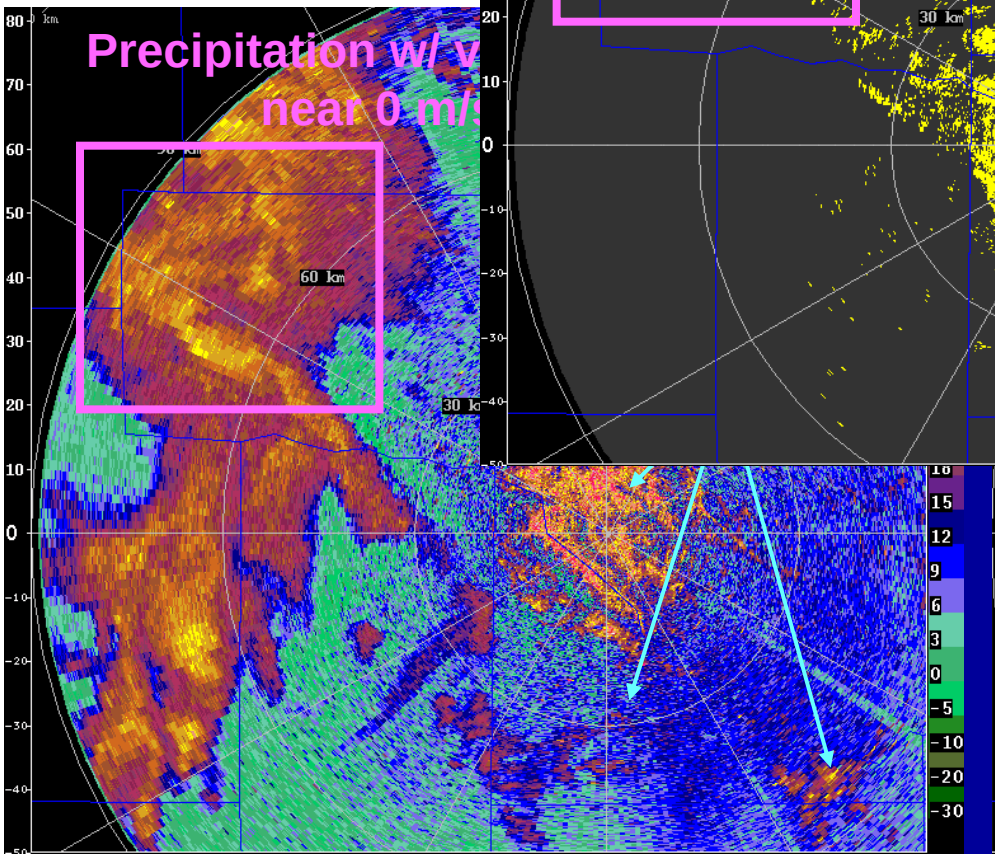
CMD Methodology and an Example

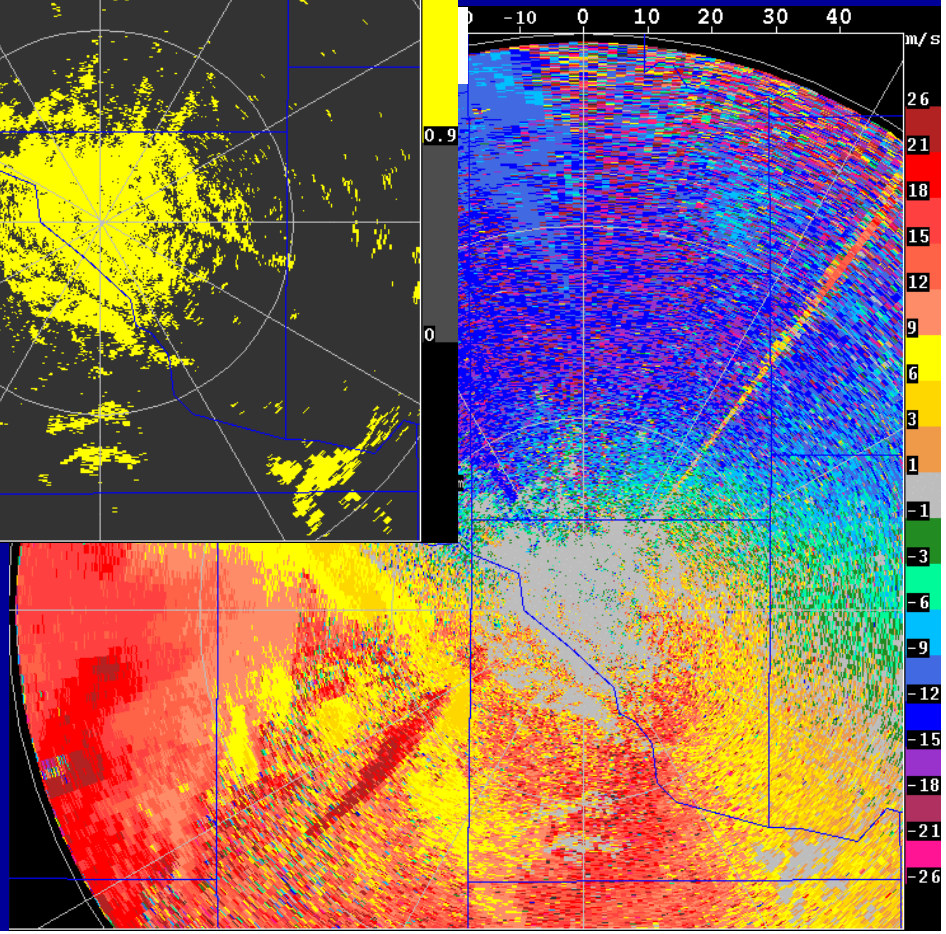
- CMD will automa
  - Fuzzy logic us n
  - GMAP applied
    - Precipitatio
- Example: KJIM s er)

Clutter Flag determined by CMD



Reflectivity – No GMA

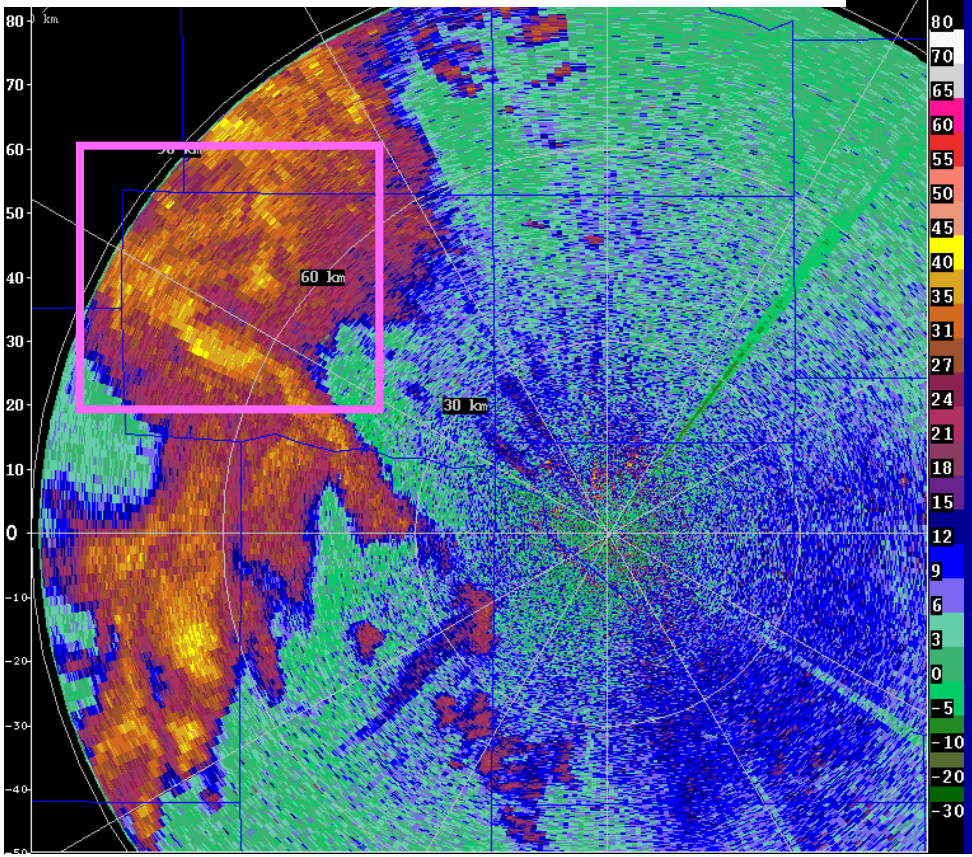




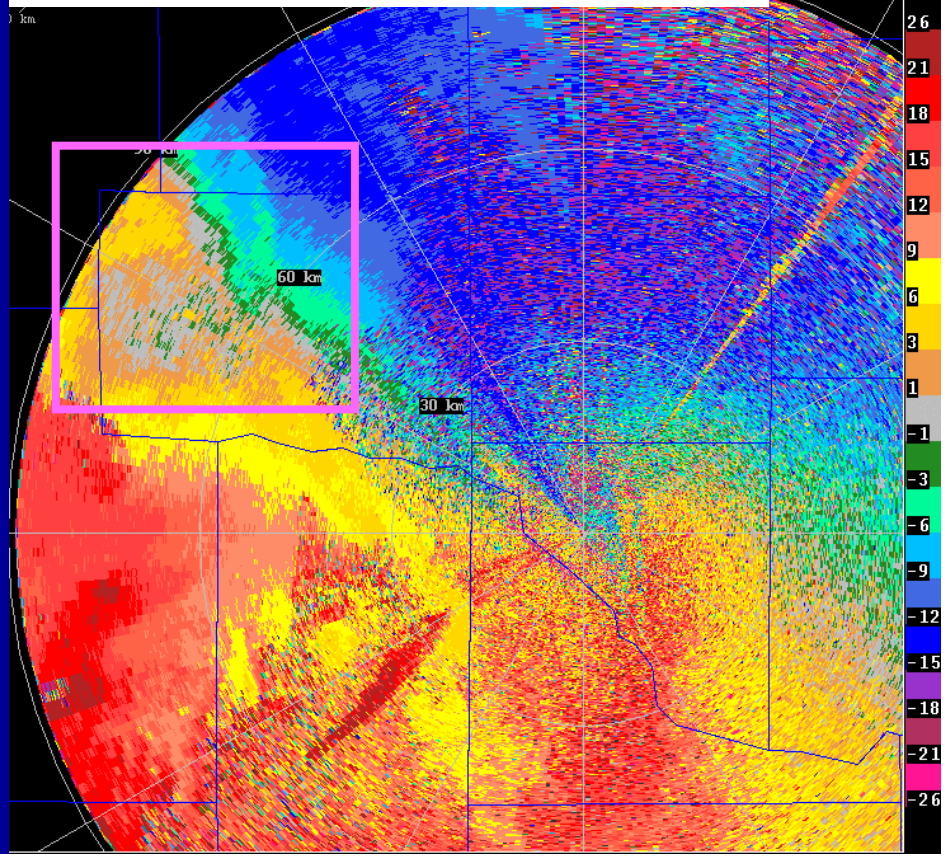
CMD Specifies Where GMAP is Applied

- Clutter flag specifies GMAP application
- Near-zero precipitation return is not clutter filtered and no bias is introduced
- NP clutter is removed and underlying signal recovered

Reflectivity – CMD turns GMAP on/off



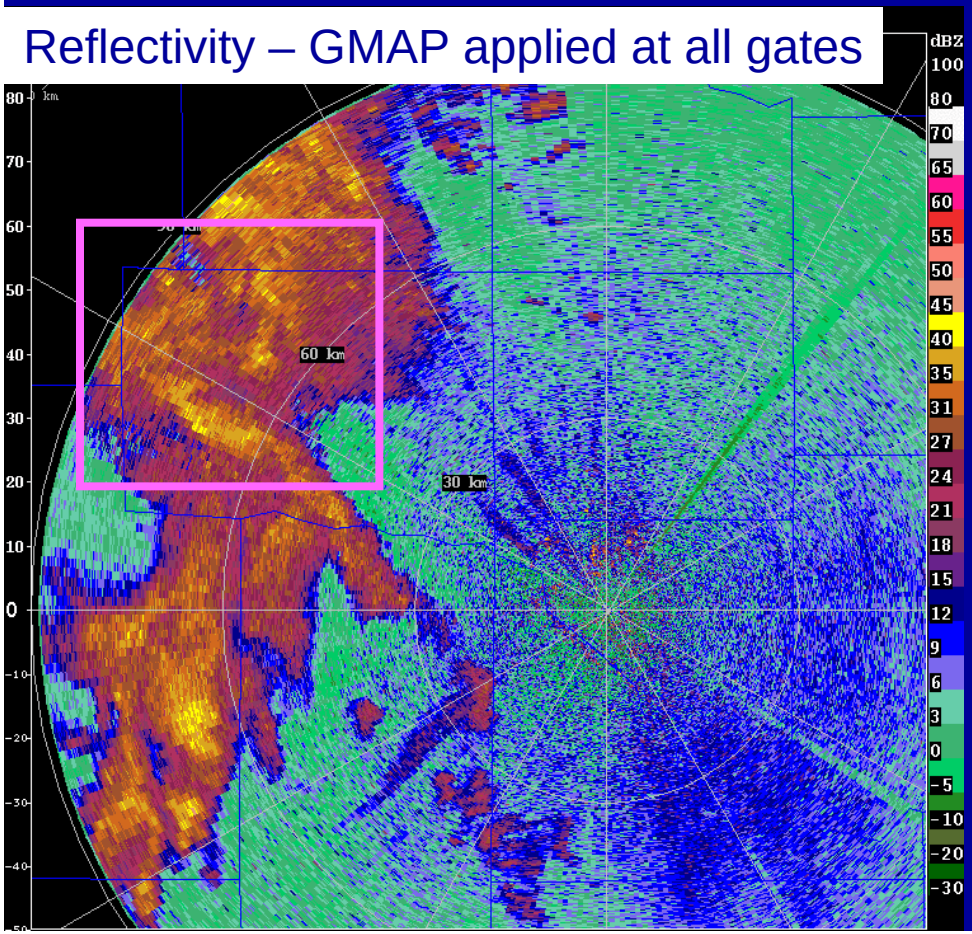
Velocity – CMD turns GMAP on/off



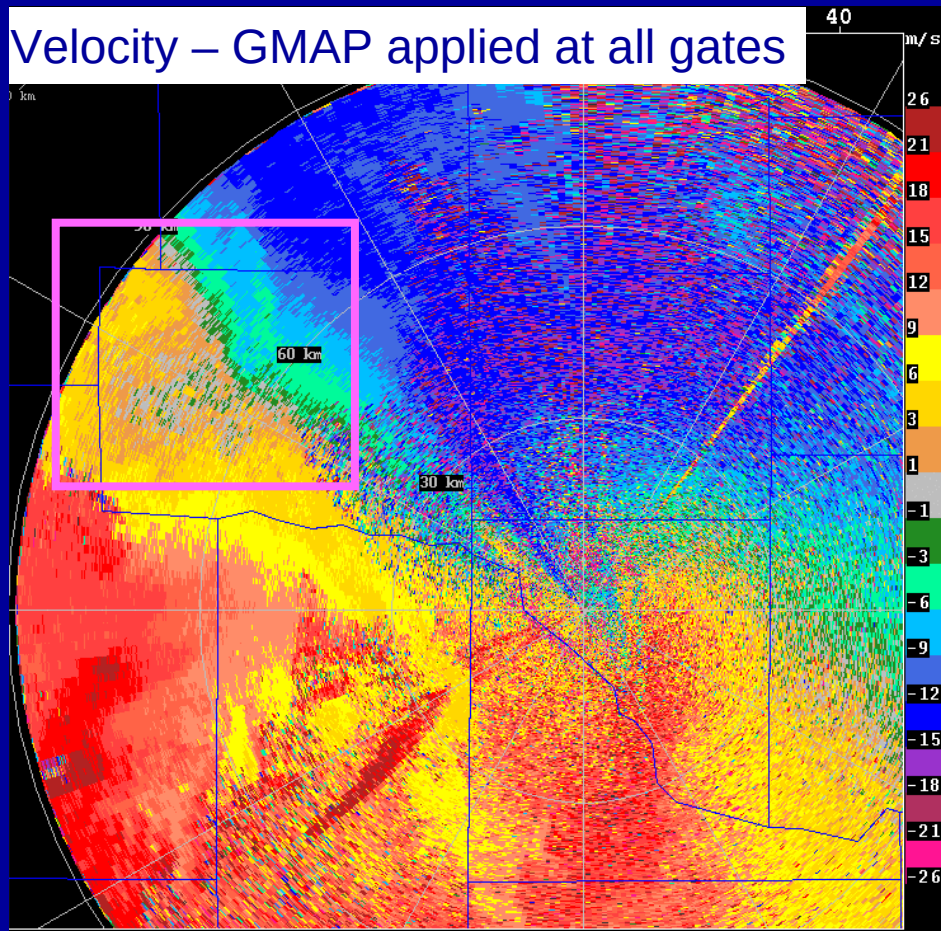
What if GMAP is Applied Everywhere?

- Example shown for comparison purposes only
  - Shows the bias that is introduced when precipitation is clutter filtered
- CMD will automate the clutter filter application decision and remove the human from this decision loop
  - Result: improved moment estimates

Reflectivity – GMAP applied at all gates



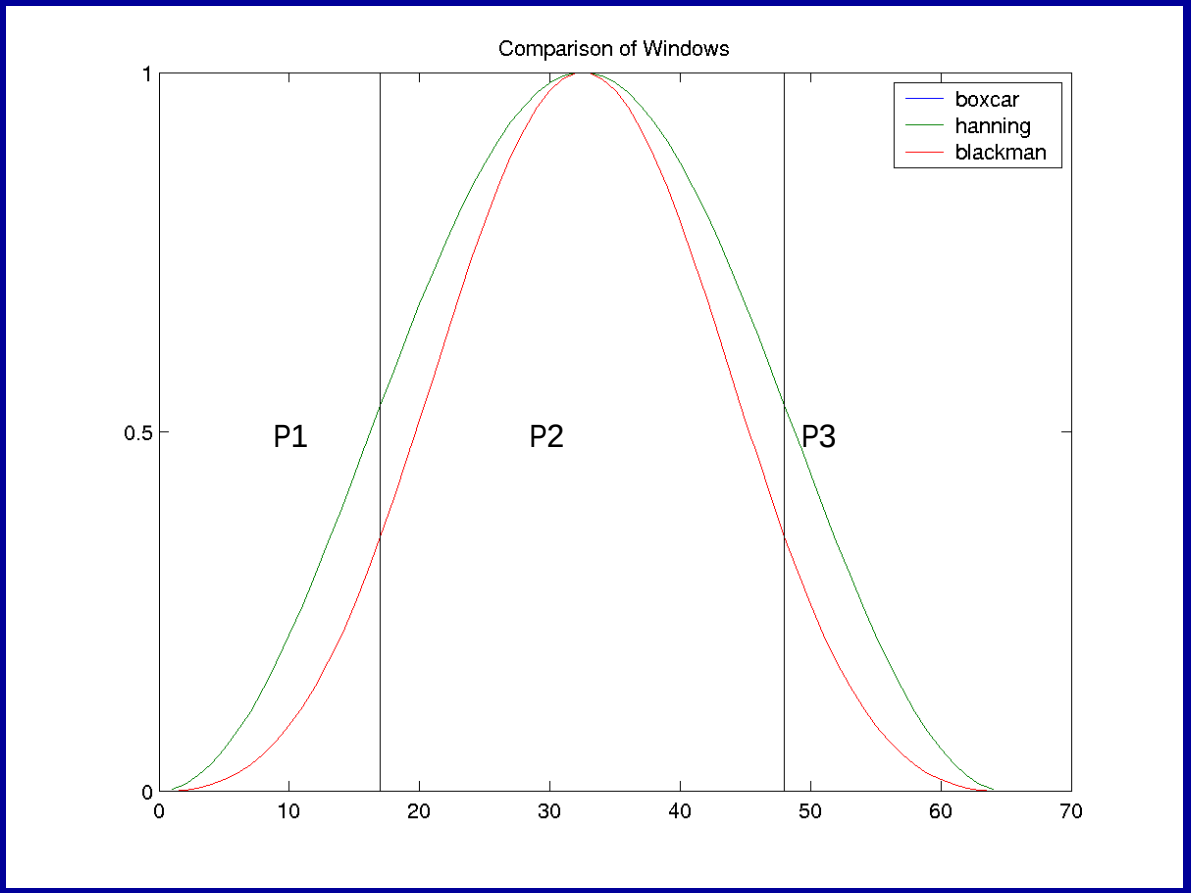
Velocity – GMAP applied at all gates



Windowing for Increased Data Quality

- Increase length of times series used to calculate momnents
- Possible to do with minimal smearing of data (i.e., decrease of resolution) due to nature of window functions used for SZ and GMAP

Hanning and Blackman Window Functions



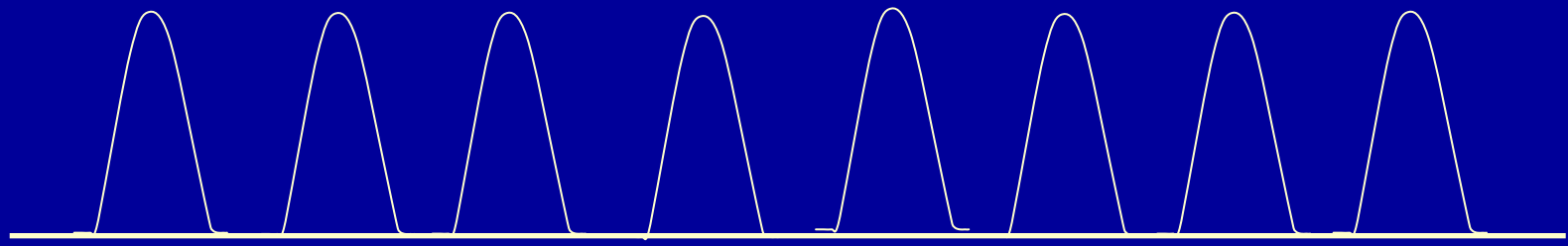
P2/(P1+P2+P3)

Hanning	91.9%
Blackman	97.0%

Most power (91.9% and 97%) come from the center half of points

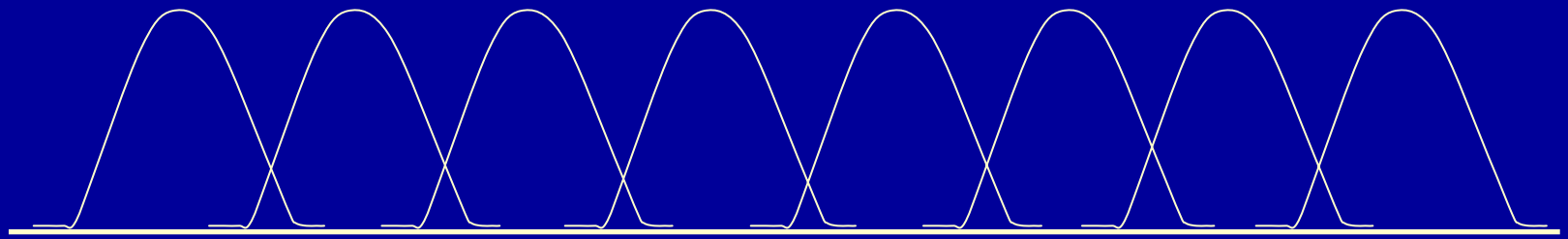
Windowing of Time Series (I/Q) Data
(for enhanced Data Quality)

Non overlapping windows



time

Overlapping windows

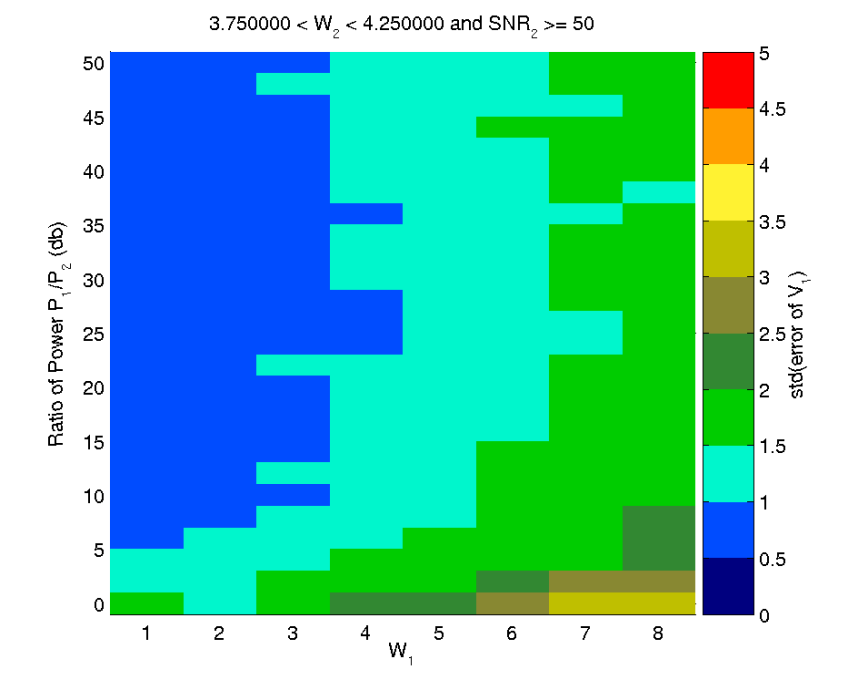


time

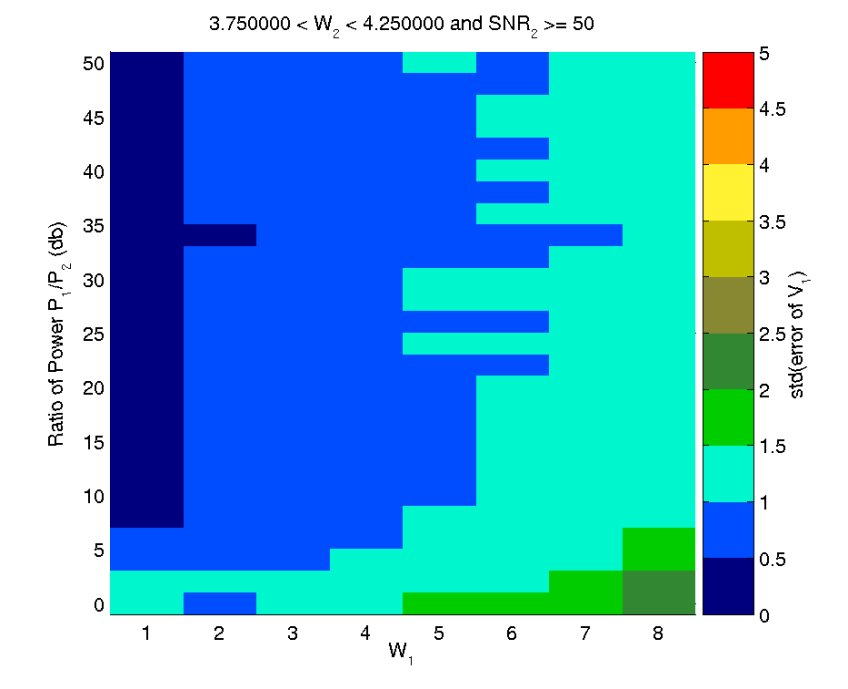
Comparison of 128 to 64 Point Window

Strong Trip Velocity
Standard Deviation

64 Point



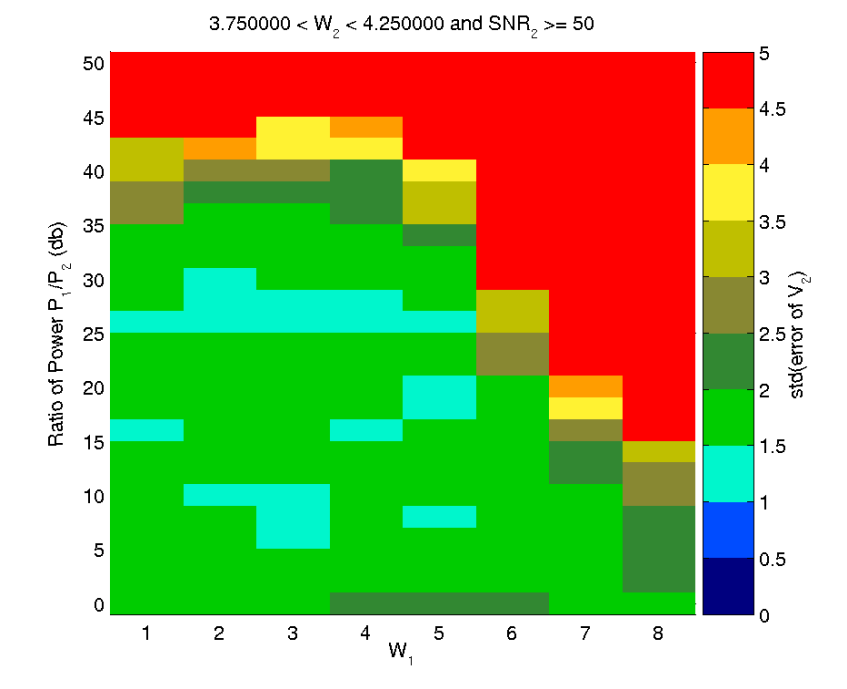
128 Point



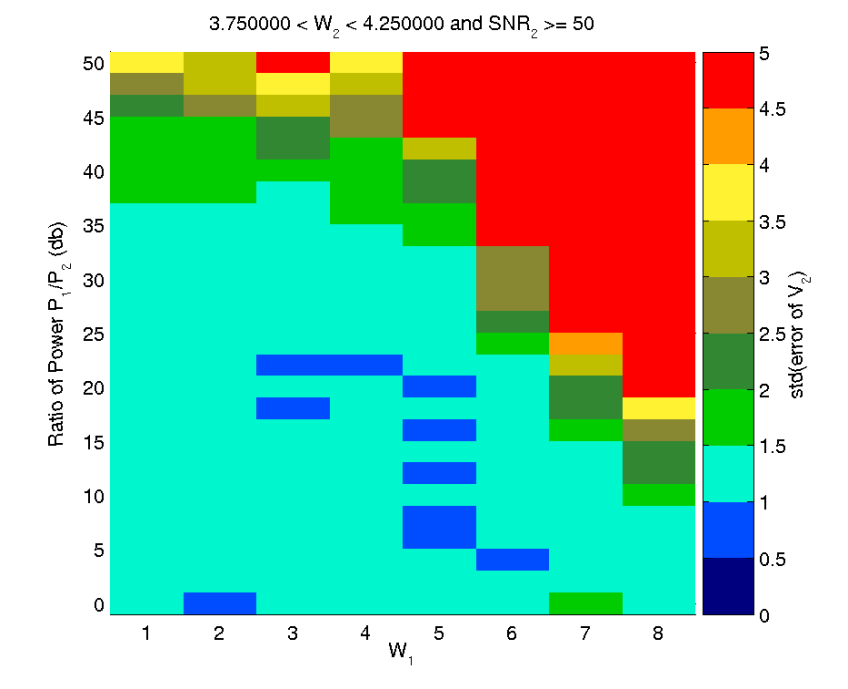
Comparison of 128 to 64 Point Window

Weak Trip Velocity
Standard Deviation

64 Point



128 Point



More Samples Means Better Data Quality

- Since the time series length is doubled, the standard deviation of estimates should reduce by about one over the square root of 2 or 30%.
- Also, GMAP performance will increase significantly, i.e., using 32 points instead of 16 points on long PRT scans.

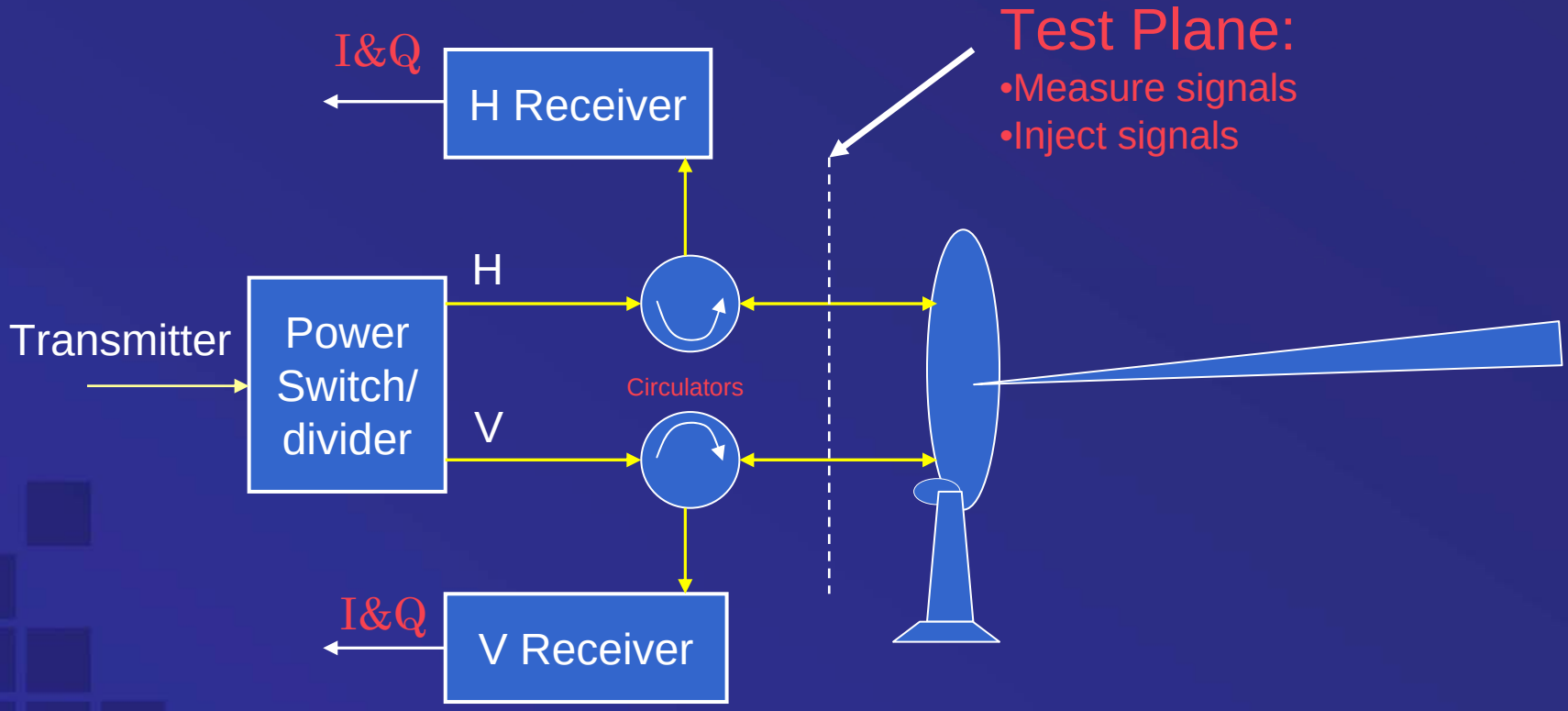
Uses for Overlapping Windows

- Since non overlapping time series windows of length N “under sample” in azimuth, overlapping windows of length 2N can be always be used instead with minimal data smearing or loss of resolution thus improving data quality
- OR since non overlapping time series windows of length N “under sample” in azimuth, overlapping windows of length N can be used to produce “Super Resolution” data as shown at previous TAC presentation. See: http://www.eol.ucar.edu/rsf/NEXRAD/nexrad_publications_links.html

Zdr CALIBRATION

- NCAR is designing a Zdr calibration experiment for OS&T
- Evaluate/verify NSSL's proposed "Engineering Calibration" method
- Evaluate/verify Crosspolar power technique
- Use S-Pol vertical pointing Zdr calibration technique for performance evaluation
- Use Z, Zdr, Kdp consistency method for addition cross checks
- Begin work this fiscal year

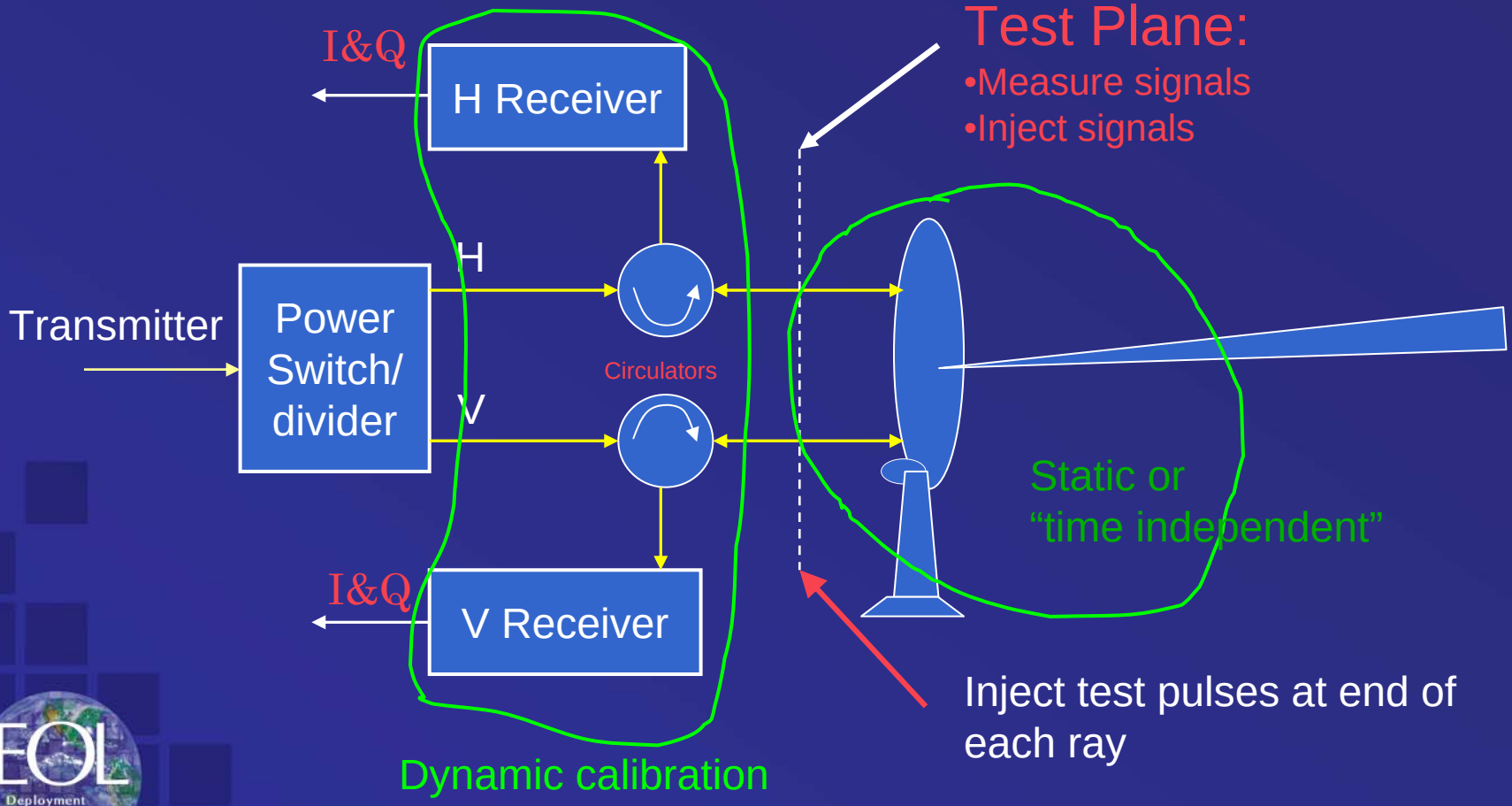
Radar Block Diagram for Zdr Calibration



Verify uncertainty of measurements over a range of environmental conditions.

NSSL Engineering Calibration

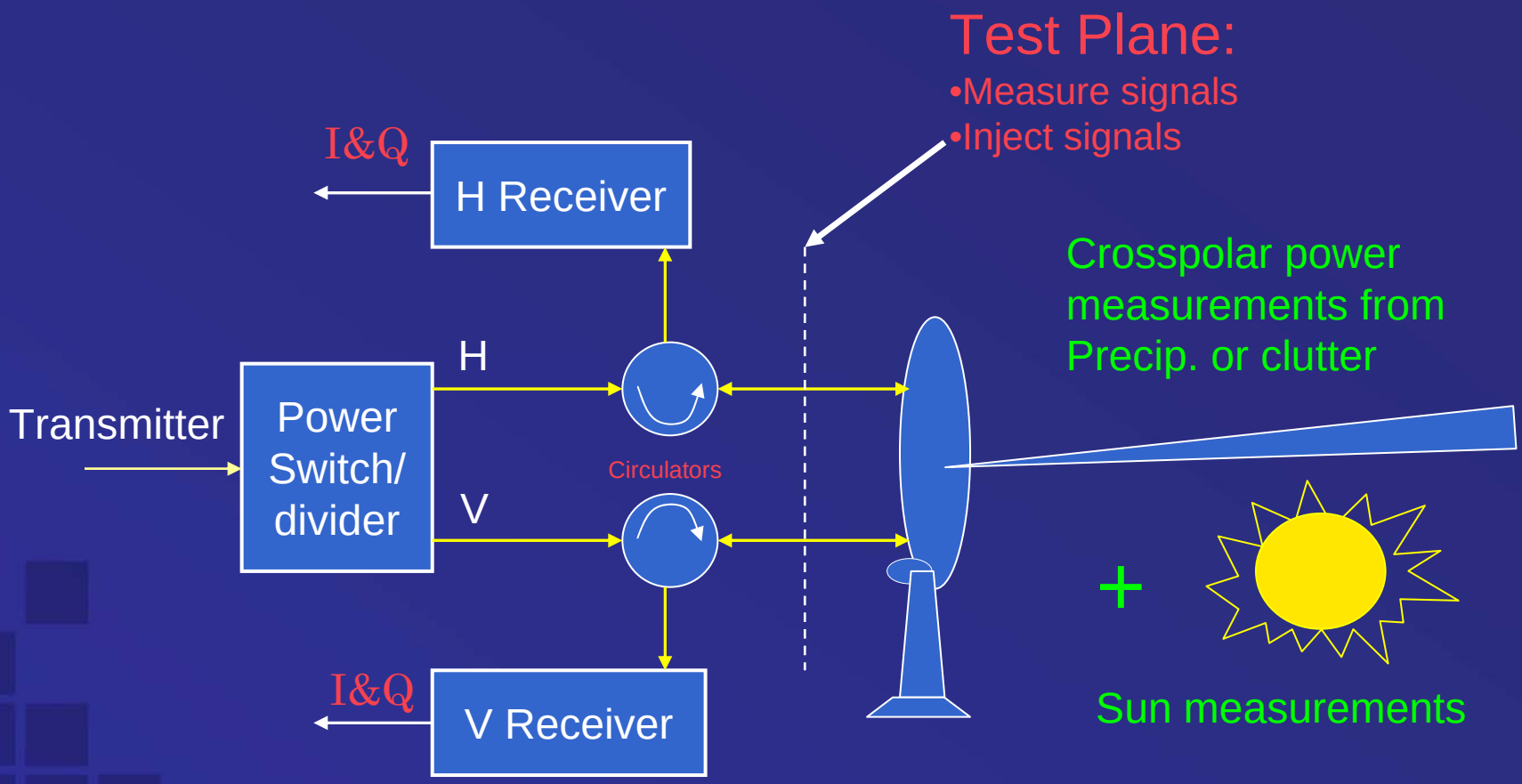
Static calibration plus dynamic monitoring



S-Pol and CHILL

- Both use this method but routinely find that there still is a Zdr bias of a few tenths of a dB
- Final Zdr calibration achieved by using vertical pointing data
- Reason for this discrepancy is assumed to be limited accuracy of measurements

Crosspolar power method



Zdr_bias=F(S,Xpol)

Thanks for your attention

Questions??

Presentation slides found at:
http://www.eol.ucar.edu/rsf/NEXRAD/nexrad_publications_links.html

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